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COMMENTARY

Level 1 Cardiac Arrest Centers: Learning from the Trauma Surgeons

More than 1000 patients die each day from out-of-hospital cardiac arrest. Although the reasons are multifactorial, it is remarkable that more than 50% of patients who are brought to the hospital alive after immediate resuscitation never survive to hospital discharge. Ultimate functional survival after an out-of-hospital cardiac arrest in the United States is approximately 5%. Patients die from heart failure, brain failure, and variable care in the intensive care unit. These grim statistics remind us of the results associated with traumatic injury more than 30 years ago, before the establishment of integrated trauma systems and the centers of excellence, the trauma centers that treat severe traumatic injury. The time is right to learn from the integrated and multidisciplinary trauma community and develop specialized care centers for patients who have been resuscitated from cardiac arrest. The overarching concept is to move the level of patient to the appropriate level of care at the right time. As a result of the development of trauma systems, integrating out-of-hospital guidelines, communication, capabilities, levels of care, trauma registry, uniform clinical practice guidelines, and practice in Level 1 trauma centers across the United States, today 50-70% of all hypotensive trauma patients survive to hospital discharge. By contrast, only about 5% of the patients with out-of-hospital cardiac arrest survive to hospital discharge, despite care by qualified emergency medical services (EMS) personnel. We believe that as a nation we can do better.

Building on the lessons and success of the trauma systems concept, it is time for the out-of-hospital and emergency medicine, cardiology, and critical care communities to develop and implement a Level 1 cardiac arrest system. This would also include Level 1 cardiac centers. Recent efforts to provide rapid care of patients with heart attacks, including standard out-of-hospital and emergency department care, around-the-clock acute interventions in cardiac catheterization laboratories, and standard intensive care unit practice approaches, suggest that this concept is feasible and that its time has come. An essential element of a trauma center is the trauma team, a group of physicians and nurses whose efforts are focused on giving the very best care to severely injured people. The

trauma team is available 24 hours a day, 7 days a week. Each team member has a specific predetermined role and each member contributes to the team. Beginning at the point of injury and continuing through the care process there are well established protocols used for the assessment and treatment of patients with traumatic injuries. Associated with these widely practiced diagnostic and treatment plans are well established scoring standards for outcomes, required trauma registry elements, and reimbursement plans to cover the costs of the intensive levels of care provided. Dedicated trauma coordinators and registrars are hired by the trauma service to record critical out-of-hospital and hospital outcomes and ultimate functional status. These critical personnel maintain the trauma registry, the backbone of the trauma system. The approach has resulted in a striking improvement in outcomes over the past three decades, with a decrease in preventable death, improved overall outcomes, and, recently, a focus on functional outcomes. Another important benefit of the trauma center is the built-in continuous quality improvement of the team, including a requisite review of the care given to critical patients in a structured recurring multidisciplinary trauma conference. This system is also designed to rapidly assess new therapies, which can be systematically evaluated within the construct of a uniform-based protocol system of care.

Like the care of patients with severe injuries 30 years ago, today's cardiology and critical care communities are in their infancy in terms of a systems approach to the patient who has been resuscitated after cardiac arrest. There are no national guidelines or standards of care for patients who have been resuscitated in the field. Preventable deaths may account for a significant portion of overall mortality. Patients are often admitted to the hospital, marginalized in a side room of the intensive care unit, and commonly die within 48-72 hours; survivors often have significant neurological deficits. In addition, because of the nature of the relationship between EMS medical directors and their in-hospital colleagues, there is usually no follow-up once a patient is delivered alive to the intensive care unit. The EMS medical directors often cannot or do not know what happens to those patients. Privacy rules thwart such a process.

Learning from our trauma colleagues, there is an opportunity to create a much more aggressive and outcome-based approach to patients after resuscita-

tion from cardiac arrest. For starters, an immediately available specialized critical care team including a physician team leader, akin to the lead trauma surgeon, should be immediately summoned to the emergency department to begin to care for the patient upon his or her arrival in the emergency department. Decisions must be made regarding immediate cooling, immediate cardiac catheterization, immediate thrombolytic therapy, and the like. Decisions regarding use of the optimal pressor agents, antiarrhythmic agents, respiratory care management, nutrition, and ways to stabilize a metabolically unstable medical condition need to be made rapidly in order to optimize the patient's chance for survival. The optimal balance between diagnostic studies and timing of intervention is critical in these patients, much like with the hemorrhagic shock patient. This is exactly the approach taken today by trauma centers, and the results have been improved survival.

An organized system with cardiac arrest centers cannot be created overnight; however, there is no need to re-create the wheel. The process leading to this highly effective means to care for severe traumatic injuries first required the recognition of the clinical need; willingness by experts to develop common protocols; willingness of government agencies to reimburse the trauma teams, including payment for around the clock trauma team coverage; and the development of the appropriate medical technology to meet the needs of the trauma patients. This kind of change in care will invariably mean that many hospitals will no longer primarily care for patients after cardiac arrest, and other centers will have to increase the resources available for this specific patient population. Although the shift in resources may have a short-term economic impact in many hospitals, the overall expense associated with the care of this patient population may actually decrease as a result of improved system-wide efficiencies and decreased length of stay associated with improved outcomes within the new specialized Level 1 cardiac arrest centers. With larger numbers of patients focused in more select centers, there will be both clinical and financial economies of scale. Such centers will be able to rapidly overcome the clinical and

financial learning curves by treating more patients more frequently, thereby achieving excellence more rapidly.

Recent studies showing clinical benefit from rapid defibrillation, improved ways to increase circulation during CPR, use of thrombolytic therapy in some patients in cardiac arrest in the field, and improved ways to cool patients after cardiac arrest, suggest that the time is right to focus on postresuscitation care with a cardiac arrest center approach. The road map has been well established by the trauma community; it is time to recognize that a similar road map must be followed if we really want to improve the long term outcomes of the 42 patients who now are dying from out-of-hospital cardiac arrest each hour of every day in America. Although creation of the specific features of this proposed road map for patients resuscitated after cardiac arrest will require a broad collaborative effort, it seems clear that a comprehensive, systematic, and rapid approach to cooling; hemodynamic stabilization; prevention of secondary injury by inflammatory processes; respiration management that includes optimization of both gas exchange and cardiac output; timely assessment of cardiac electrical, mechanical, and vascular functionality; and efforts to prevent secondary brain injury should form the foundation of a system-wide care in Level 1 cardiac arrest centers. Building on the recent establishment of the NIH Resuscitation Outcomes Consortium to assess out-of-hospital care for patients suffering from out-of-hospital cardiac arrest, it is time for the emergency medical, critical care, and cardiology communities to come together and work toward defining, validating, and practicing a uniform and higher standard of care for patients who are admitted to the hospital after successful resuscitation from sudden cardiac death. Only then will we truly be able to have an impact on this devastating disease process.—**Keith G. Lurie, MD** (lurie002@tc.umn.edu), *Department of Emergency Medicine, Hennepin County Medical Center, Minneapolis, MN*, **Ahamed Idris, MD**, *Department of Emergency Medicine, University of Texas Southwestern, Dallas, TX*, and **John B. Holcomb, MD**, *the U.S. Army Institute of Surgical Research, Fort Sam Houston, TX*
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